Manual dexterity of older Mexican American adults: a cross-sectional pilot experimental investigation

Arunkumar Pennathura,*, Luis Rene Contrerasa, Karina Arcautea, Winifred Dowlingb

a Mechanical and Industrial Engineering Department, University of Texas at El Paso, El Paso, TX 79968-0521, USA
b Aging Services Administration, City of El Paso, USA

Received 23 March 2003; received in revised form 29 May 2003; accepted 7 July 2003

Abstract

This paper reports results from an experimental pilot study performed to quantify the manual dexterity of older Mexican American adults. The Purdue pegboard test, a two-arm coordination test, and a hand-tool dexterity test were used in this study. To enable cross-sectional comparisons of manual dexterity measures of older Mexican American adults with young Mexican American adults, these tests were administered to 18 older Mexican American adults aged 63–85 (mean age: 71.3 years, SD: 7.0 years), recruited from senior recreation centers in El Paso, and eighteen young adults aged 21–32 (mean age: 25.6 years, SD: 3.8 years) recruited from the student body at the University of Texas at El Paso. For the Purdue pegboard test, the number of pegs placed in 30 s using the preferred hand, the non-preferred hand, and both hands were first individually monitored. Then, scores on an assembly task using the Purdue pegboard were obtained. For the two-arm coordination test, participants were required to trace a star pattern with a stylus using both hands. The time for task completion and the number of errors made during task performance were monitored. For the hand-tool dexterity test, participants were required to use common hand tools and remove nuts and bolts from one side of a wooden upright, and to assemble nuts and bolts in the corresponding holes on the other side of the upright. The time taken for task completion was recorded. Since modified Levene’s test showed equality of variances, two sample t-tests, comparing the mean responses of older adults with the mean responses of young adults for each individual test, were conducted. Results indicate that responses for the older adults were statistically significant different (p < 0.001) from young adults for all Purdue pegboard tasks. On the average, older adults performed significantly slower (p < 0.001) than young adults on the two-arm coordination test, and committed more errors before task completion (p < 0.05). Older adults also took longer to complete the hand-tool dexterity task compared to their younger counterparts (p < 0.05). In addition to the t-tests, manual dexterity performance measures from older adults were regressed with age to determine the cross-sectional age effects on manual dexterity measures. Results indicate that all Purdue pegboard performance measures were significantly affected by age (p < 0.05). The time to complete the two-arm coordination test was significantly linearly related to age (p < 0.05). However, the number of errors committed by older adults in the performance of the two-arm coordination test was not significantly linearly related to age. Time to complete the hand-tool dexterity was also significantly linearly related to age (p < 0.05). Accommodating age-related changes in manual dexterity is important for job design in industry, especially in industries employing older adults requiring significant assembly and hand-tool use.

*Corresponding author. Tel.: +1-915-747-7988; fax: +1-915-747-5019.
E-mail address: apennathur@utep.edu (A. Pennathur).

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doi:10.1016/j.ergon.2003.07.001
Relevance to industry

Given the aging of the industrial workforce, it is important to understand how manual dexterity is affected by age, so that jobs requiring significant manual dexterity for task initiation, task performance and task completion are designed to fit older adult dexterity levels.

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Keywords: Older worker; Manipulative skills; Dexterity

1. Introduction

Increasing life expectancy, low childhood-mortality rates, declining fertility rates, improved nutrition, and public and personal hygiene are resulting in a marked redistribution of the population towards an older median age in the US. According to the United Nations’ Demographic Indicators, the US experienced nearly a 12% increase from 1980 to 2000 in people of ages 65 and older. During the same time period, the proportion of older adults aged 80 and over increased by nearly 39%. These numbers are expected to further increase by 33% and 14%, respectively, during the period 2000–2020 (Anderson and Hussey, 2000). According to recent survey data from the Administration on Aging of the US Department of Health and Human Services (Administration on Aging, 1999), in the US, persons 65 or older numbered 34.4 million in 1998. They represented nearly 13% of the US population, or about one in every eight Americans. Since 1900, the percentage of Americans aged 65 and older has more than tripled, and increased 11-fold in numbers (3.1 million to 34.4 million).

In addition to the overall aging trend observed in the US, several specific characteristics of the aging trend make designing for the older adult an imperative need. Survey data from the Administration on Aging (1999) show that the older population itself is further aging—in 1998, in the US, the 65–74 age group was 8 times larger than in 1900, but the 75–84 group (12 million) was 16 times larger and the 85 plus group was 33 times larger. In 1997, persons reaching age 65 had an average life expectancy of an additional 18 years.

A child born in 1997 could be expected to live approximately 77 years, 29 years longer than a child born in 1900. In 1998 alone, based on the birth and death rates, there was a net increase of about 396 persons aged 65 and older per day. It is expected that the older population will continue to grow significantly between 2010 and 2030 when the baby boomer generation reaches age 65. By 2030, 70 million older persons are expected to live in the US, more than twice the number in 1998. People 65 and older are expected to be almost 20% of the US population by the year 2030.

Older adults continue to stay in, or return to the workforce, in large numbers. The decline in contributors and the increase in non-contributors to social security and health benefits programs, due to fall in population growth and aging of the population, may make it impossible for many older Americans currently in the workforce to retire (Deaton, 1987; Bayo and Faber, 1981; Anderson and Hussey, 2000). Further, this may force many retired workers to reenter the workforce. Economic necessities of independent living may also force older Americans to postpone retirement or reenter the workforce (Hudson Institute, 1997). Data trends in labor-force participation in the US show that, in 1998, about 3.7 million older Americans (12% of the total population) were working or actively seeking work, including 2.2 million men and 1.6 million women. These older workers constituted 2.8% of the US labor force. By the year 2030, it is projected that at least one in every ten US workers will be aged 60 and older. The ratio of persons aged 15–64 (considered normal working age) to persons aged 65 and older has been decreasing steadily since 1960, and is expected to be between two and four
potential workers for every older adult in the US in 2020 (Anderson and Hussey, 2000).

The problem of aging especially impacts minority populations, particularly the Hispanic population. Survey statistics show that aging minorities will represent nearly a quarter of the elderly population in 2030, which is up from about 16% in 1998. Between 1998 and 2030, the white population over 65 years of age is projected to increase by 79% compared with 341% for older Hispanic adults (Administration on Aging, 1999). Several studies show that compared to other minority groups, older Mexican Americans have higher rates of activity limitation, especially in activities of daily living in home and other environments (Espino and Burge, 1989; Markides et al., 1989, 1997; Lacayo, 1992; Sotomayor and Garcia, 1993; Winkleby et al., 1993; Chiodo et al., 1994; American Association of Retired Persons Minority Affairs, 1995; Martin and Soldo, 1997). Despite such overwhelming survey data on problems of older adults, in general, and older Mexican American adults, in particular, in performing activities of daily life, there is very little work-relating specific age-related functional changes to the corresponding changes in abilities to perform daily living tasks (Clark et al., 1990).

The nature of what are considered “work” activities also changes with age, especially among retired older adults—the nature of work is expected to change from being advanced activities of daily living such as heavy physically demanding work in an industrial setting (AADL), to being basic activities of daily living (BADL) such as self-care and grooming activities. Impairment in the performance of activities of daily living, especially in household settings (opening a can of tomatoes, for example), is considered far more complex than cellular or molecular mechanisms of aging due to complex body and environmental systems involved (Clark et al., 1990; Lawton, 1990; Smith, 1990; Kumar, 1997). Surveys (Dawson et al., 1987; AARP, 2000; Pennathur et al., 2003) have shown that older adults have difficulty in performing one or more common self-care activities such as eating, using the toilet, dressing, bathing, or preparing meals in the kitchen. Other activities considered “work” related, such as walking up 10 steps, standing for 2 h, stooping, crouching or kneeling, lifting or carrying 25 pounds, etc., have been found to be difficult tasks for older adults to perform (Kovar and LaCroix, 1987; Meindl and Freivalds, 1992; Vayrynen et al., 1996; Kirvesoja et al., 2000). Older adults performing these activities of daily living have been found to need assistance when performing these activities.

Given the steady increase in the aging of the labor force in the US and other countries, and given the decline in muscle mass and other functional capacities such as force for task performance, speed, and endurance and dexterity with age (Chi and Lin, 1998; Kawakami and Kumashiro, 1999; Latash and Turvey, 1996), it is important to quantify manual dexterity of older adults not only for design of work, but also for the design of products and systems of daily use by older adults. This paper reports results from an experimental pilot study conducted to quantify manual dexterity skills of older Mexican American adults.

2. Materials and methods

2.1. Participants

Eighteen older adults (ages 63–85, average age 71.3 years) participated in this study. Of the eighteen, 12 participants were female and 6 were males. Older adult participants for the study were recruited from senior recreation centers in the City of El Paso. All older adult participants in the study were of Mexican origin. Older adults who had a history of arthritis or other muscle-related discomfort in the hands or shoulders were excluded from this study. All older adult participants lived independently in their own home, and led active lives (as evidenced by their participation in daily planned activities in senior recreation centers). Eighteen young adults (ages 21–32, average age 25.6 years) were recruited from the student body at the University of Texas at El Paso to participate in this research study. All participants in the study were volunteers and were not paid any monetary or other compensation for their participation.
2.2. Tools and equipment

Manual dexterity skills in this experiment were measured using a battery of three tests, the Purdue pegboard test, the two-arm coordination test, and the hand-tool dexterity test. The equipments used are described in greater detail in the following sections.

2.2.1. Purdue pegboard

The Purdue pegboard is intended to measure two types of activities: (1) gross movements of the hands, fingers and arms; and (2) finger dexterity, which can be considered the ability to integrate speed and precision with finely controlled discrete movements of the finger. Purdue pegboard Model #32020, manufactured by Lafayette Instrument Company, was used in this experiment. This apparatus (Fig. 1) is a wooden pegboard with four cups for pins, collars and washers at the top of the board, and two columns of 25 holes each at the center of the board. The four tests possible with this equipment are a test with the right hand, a test with the left hand, a test with both hands, and an assembly test.

2.2.2. Two-arm coordination test

The two-arm coordination test (Model #32532 from Lafayette Instrument Company) was used in this research. The two-arm coordination test (Fig. 2) is intended as a measure of the ability to move both arms in a simultaneous and coordinated manner. The movement involved is that of the whole arm related to the ability of operating–controlling and driving–operating. The equipment consists of a tracing board with a black star pattern, a stylus and an impulse counter. The actual test, which is composed of two operations, is tracing a star in a clockwise direction and in a counterclockwise direction. The stylus is manipulated by moving the handles in the apparatus and spreading the handles. Moving the handles makes the stylus move toward the top of the board, while bringing the handles together moves the stylus downward on the board. Lateral movement is accomplished by simultaneously moving both handles to the left or to the right. The objective of the test is to manipulate the handles in such a way as to keep the stylus on the black star pattern. Every time the stylus leaves the black star pattern,
an impulse counter connected to the stylus will record one error. Both the time for task completion, which is recorded with a stop watch, and number of errors made during task performance, are collected during this test.

2.2.3. **Hand-tool dexterity test**

The goal of this test is to measure the dexterity of participants when using common hand tools. The hand-tool dexterity test Model #32521 available from Lafayette Instrument Company was used. Manipulative skill, independent of intellectual factors, is measured in this test. Skills such as intelligence and understanding of mechanical principles for using hand tools are not measured. The equipment (Fig. 3) used for the hand-tool dexterity test consists of a wooden frame with two uprights. The entire frame is mounted on a table that is considered to be a workbench. Nuts and bolts, with bolt heads on the inside of the frame, are placed in the holes on the frame upright left of the participants. The tools used in the test are common wrenches of different sizes. The tools are placed at the center of the frame between the uprights. The objective of the test is to remove all the bolts from the left upright and place them on the corresponding right upright with the heads of the bolts on the inside using the tools provided. The time taken to remove all the bolts from one upright of the wooden frame, and place the bolts in the corresponding holes on the other upright is the performance measure in this test.

2.3. **Procedure**

Older and young adult participants first signed the informed consent form approved by the Institutional Review Board at the University of Texas at El Paso. Participants then proceeded to perform the battery of tests in accordance with the procedures outlined in the following sections for each test.

2.3.1. **Purdue pegboard test**

In preparation for the Purdue pegboard test, participants were seated comfortably at a normal table height (30°). The pegboard was placed directly in front of the participants, with cups containing pins, collars and washers at the far end of the pegboard. It was ensured that cups at the extreme right and extreme left of the center contained 25 pins each, and the cups immediately to the right and left of the center contained 50 collars and 100 washers each, respectively. Participants were then instructed that the goal of the experiment is to determine how many pegs, or assemblies for an assembly task, they could complete in 30 s. They were then walked through the tasks by the experimenter, and were allowed time to practice each task until they felt comfortable. They were also reminded that, in the actual test, they should not worry about pins or other assembly components that drop, and should proceed with the experiment using components that were available on the pegboard. For tests with only one hand, depending upon the dominant hand of the participant, instructions were then provided for the right-handed test and the left-handed test. For the right-hand test, participants were instructed to pick one pin at a time with their
right hand from the right-hand cup. They were then to place each pin in holes along the right-hand column of the pegboard, beginning from the top hole. Participants were instructed that they had to place as many pins as they could, working as rapidly as possible, until the investigator requested them to stop at the end of 30 s. The number of pins placed in 30 s with the right hand, which was monitored with a stop watch, was recorded. For the left-hand test, participants were instructed to pick one pin at a time with their left hand from the left-hand cup. Participants were instructed to place the pins in holes along the left-hand column of the pegboard beginning from the top hole, working as rapidly as possible. The number of pins placed in 30 s with the left hand was recorded. For the test using both hands, participants were instructed that they were to use both hands at the same time for the tasks. They were instructed to pick up a pin from the right-hand cup with their right hand, and at the same time pick up a pin from the left-hand cup with their left hand. They were to then place the pins down the right-hand and the left-hand column of the pegboard, respectively, beginning from the top of the board. The total number of pins placed with both hands in a 30-s time interval was recorded. For the Purdue pegboard assembly task, participants were instructed to pick up one pin from the right-hand cup with their right hand, and while they were placing it in the top hole along the right-hand column of the board, to pick up a washer with their left hand. As soon as a pin was placed, they were instructed to drop the washer over the pin. While the washer was being placed, participants were to pick up a collar with their right hand. While the collar was being dropped over the pin, they were to pick up another washer with their left hand and drop it over the collar. This series of tasks completed the first assembly consisting of a pin, a washer, a collar and a washer. Participants were instructed that when the final washer for the first assembly was being placed with their left hand, they were to begin the second assembly immediately by picking up another pin with their right hand, and continue placing it in the next hole. The total number of pieces assembled in 30 s was recorded. Since each assembly consisted of four pieces, each piece placed in the pegboard was counted as a point, and each complete assembly was counted four points.

2.3.2. Two-arm coordination test

Older and young adult participants were first instructed on the objective of the test. They were then provided time to familiarize themselves with the apparatus by using the stylus and moving the handle on the star pattern. Beginning from the top of the star, participants traced the star pattern first in a clockwise direction. Once the stylus was at the top of the star pattern, the task was repeated in a counterclockwise direction. The total time participants took to complete both the clockwise and the counterclockwise tracing was recorded with a stop watch. The impulse counter was used to record the number of times the participant, while tracing the star pattern, went out of the pattern, which was quantified as error.

2.3.3. Hand-tool dexterity test

Participants were first informed that the goal of the test was to measure participants’ dexterity in using common hand tools. After the test bench was mounted on a table at normal working height, the wrenches to be used in the test were placed in the center of the frame between the uprights. It was ensured by the experimenter that nuts on the bolts were not too tight or too loose. The experimenter then demonstrated the entire protocol to the participants. All bolts from the top row of the left upright were removed first and then laid on the bench. The nuts on all rows were loosened subsequently to be able to spin off the nuts with fingers. The bolts in the middle row were then removed and laid on the bench. As and when each bolt in the bottom row was removed, it was placed in the corresponding hole in the right upright. All the smallest bolts were mounted and the nuts were tightened initially with the fingers and then with the use of appropriate-size wrench. The middle row containing the medium-sized bolts was then mounted and tightened with nuts. The top row of bolts was then mounted and nuts tightened following the same procedure. Participants were explicitly instructed not to apply too much wrench pressure, but make the fastening sufficiently tight.
so that the nuts could not be removed with just the fingers. After the demonstration, participants were instructed to proceed with the test. The total time taken for removing nuts and bolts from all rows on one side of the upright, and mounting all nuts and bolts in the corresponding rows on the other side of the upright was recorded with a stopwatch. This total time was used as the performance measure.

2.4. Data analyses

Since this study is a pilot study, data from both males and females were combined. Summary statistics including the mean, standard deviation, and ranges were first obtained for the older adult group, and then the younger adult group. Equality of variances was first tested using the Modified Levene's test for homogeneity. Since error variances were found equal, a two-sample t-test was conducted to compare the mean responses from older adults with mean responses from younger adults. p-Values and 95% confidence intervals were computed for the mean differences between older and young adults for all the manual-dexterity test measures used in this research. In addition, to determine if and to what extent age affected manual dexterity, a regression was carried out with manual-dexterity test outcomes as the responses, and age as the factor. All statistical analyses were carried out using Minitab Version 13.31 statistical analysis software.

3. Results

Tables 1 and 2 present summary statistics based on the different tests for older Mexican American adults (men and women together), and young Mexican American adults (men and women together), respectively. Table 3 presents the results of two sample t-tests performed to compare the performance of older Mexican American adults with the younger adult cohort (males and females combined in both groups), and 95% confidence intervals for differences in mean performance measures. Results indicate that older Mexican American adults placed fewer pins using both their preferred and non-preferred hands compared to young adults (p<0.001). Results also indicate that compared to young Mexican American adults, older adults placed fewer pins while using both hands (p<0.001), and completed fewer assemblies (p<0.001). On the average, older Mexican American adults performed significantly slower (p<0.001) than young adults on the two-arm coordination test, and committed more errors before task completion (p<0.05). Older Mexican American adults also took longer to complete the hand-tool dexterity task compared to their young-

Table 1
Summary statistics for different tests for older adults (n=18, female and male data combined)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>71.3</td>
<td>7.0</td>
<td>63</td>
<td>85</td>
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<tr>
<td><strong>Purdue pegboard test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preferred hand</td>
<td>12.9</td>
<td>2.1</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>Non-preferred hand</td>
<td>11.3</td>
<td>2.1</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>Both hands</td>
<td>9.5</td>
<td>2.2</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Assembly</td>
<td>21.5</td>
<td>7.9</td>
<td>6</td>
<td>35</td>
</tr>
<tr>
<td><strong>Two-arm coordination test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time (min)</td>
<td>2.2</td>
<td>0.875</td>
<td>1.07</td>
<td>4.52</td>
</tr>
<tr>
<td>Errors (number)</td>
<td>5.6</td>
<td>3.54</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td><strong>Hand-tool dexterity test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time (min)</td>
<td>10.2</td>
<td>4.36</td>
<td>4.40</td>
<td>18.18</td>
</tr>
</tbody>
</table>
er counterparts \((p < 0.05)\). Manual-dexterity performance measures from older Mexican American adults were regressed with their age to determine cross-sectional age effects on manual-dexterity measures (Table 4). Results indicate that all Purdue pegboard performance measures were significantly affected by age \((p < 0.05)\). Time to complete the two-arm coordination test was significantly linearly related to age \((p < 0.05)\). However, the number of errors committed by older Mexican American adults in performance of the two-arm coordination test was not significantly linearly related to age. Time to complete the hand-tool dexterity was also significantly linearly related to age \((p < 0.05)\).

### 4. Discussion

In general, several elements influence task performance with upper extremities, especially in tasks that require manual dexterity for task initiation, task performance and task completion—these include (a) locating a target requiring
the coordination of eye–head movements; (b) reaching, involving transportation of the arm and hand in space; (c) manipulation, including grip formation, grasp, and release; and (d) postural control. The tests administered in this research include all these elements.

Results from our study show a significant difference in manual-dexterity measures between older and young adults. Very few studies have been performed examining the manual-dexterity abilities of older adults, using the task batteries used in this research. Francis and Spirduso (2000), in investigating the degree to which the decline is symmetrical in the two hands in comparison to young adults, found that age was related to preferred hand-task performance on manual-dexterity tasks. However, there was differential (between young and old) asymmetry in task performance seen only in the most complex, speeded task. Using Purdue pegboard tasks, Haward and Griffin (2002) found in a group of older adults employed in a university (aged 45–55 years) that the median scores in men with the preferred hand was 16.0 (with an interquartile range of 13.8–18). Among women aged 45–55 years, the median score with the preferred hand was 16.5 (with an interquartile range of 14.8–17).

When participants in their study used the non-preferred hand, median scores were 14.0 for men (with an interquartile range of 13–15), and 15.0 for women (with an interquartile range of 13–16). Average Purdue pegboard measures in our study (with older adults with an average age of 71.3 years) show that older adults achieved a score of 12.9 with the preferred hand, and 11.3 with the non-preferred hand. Our study results are comparable to results reported by Desrosiers et al. (1995, 1999). In their study, Desrosiers et al. (1995, 1999) found a decrease in dexterity with increase in age for both men and women participants aged 60 years and older. Men aged 60–69 years of age had mean scores of 12.7 for both right and left hands; women aged 60–69 years had mean scores of 14.3 and 13.7 for the right and left hands, respectively. Our study also shows that older Mexican American adults took much longer than their younger counterparts in the two-arm coordination test. According to established normative data from the manufacturer of the two-arm coordination test, a time of 1.17 min is considered a high score, a time of 1.67 min is considered average score, and a time of 3.33 min and over is considered a low score. In terms of accuracy, an error of 1 is considered a high score, 5 is considered an average score, and 20 or more errors is considered a low score. Although these data from the manufacturer do not provide any information on interpretation of their scores vis-à-vis age, based on this data, older adult participants in our study reported an average of 2.221 min, which would be considered a low score. Older adults in our study had a slightly below average score (5.67 errors) for the number

<table>
<thead>
<tr>
<th>Test</th>
<th>Regression Model</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purdue pegboard test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(number of pegs (or assemblies)/30 s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preferred hand</td>
<td>24.9893–0.170543 (Age)</td>
<td>0.018</td>
</tr>
<tr>
<td>Non-preferred hand</td>
<td>22.7501–0.158614 (Age)</td>
<td>0.048</td>
</tr>
<tr>
<td>Both hands</td>
<td>22.5395–0.182939 (Age)</td>
<td>0.010</td>
</tr>
<tr>
<td>Assembly</td>
<td>80.4556–0.827124 (Age)</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Two-arm coordination test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time (min)</td>
<td>−4.41689 + 0.09331 (Age)</td>
<td>0.005</td>
</tr>
<tr>
<td>Errors (number)</td>
<td>Not significant</td>
<td></td>
</tr>
<tr>
<td><strong>Hand-tool dexterity test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time (min)</td>
<td>−18.1475 + 0.399435 (Age)</td>
<td>0.004</td>
</tr>
</tbody>
</table>
of errors made during the two-arm coordination test.

Older Mexican American adults in our study took an average of 10.24 min in completing the hand-tool dexterity test. There are no studies reporting hand-tool manipulation abilities of older adults in the research literature; therefore, it is difficult to compare the performance of older Mexican American adults in our study with any norms for older adults. However, hand-tool dexterity of older Mexican American adults in our study was significantly different from young Mexican American adults. Among older Mexican American adults, age affected time to complete the hand-tool dexterity test. These two results together suggest a decline in older Mexican American adults’ capability to manipulate common mechanics’ hand tools. Occupation is an important variable that can affect the manipulatory skills of older adults (Haward and Griffin, 2002), since the variable that can affect the manipulatory skills of mechanics’ hand tools. Occupation is an important variable that can affect the manipulatory skills of older adults (Haward and Griffin, 2002), since the extent of motor learning that occurs during the job, can influence manual dexterity and manipulatory skills. For this study, all older Mexican American adults were retired. Some reported that, in their active working life, they were part of the assembly industry in the El Paso-Juarez border maquiladora industry.

Studies investigating the influence of exercise behavior and social network and emotional support among older adults have shown that decline or improvement in performance indicators including manual-dexterity is not uniformly associated with increases in age (Seeman et al., 1994, 1995). Other studies among non-disabled blue-collar workers aged 45 and over have shown that from a vocational perspective, age does not influence basic vocational competencies including planning ability, coordination, muscular power, physical tolerance, manual dexterity or sense of equilibrium (Kikuchi and Murakami, 1995). The effect of musculoskeletal function, particularly grip strength, on manual-dexterity measures in older adults is inconclusive at the current time (Haward and Griffin, 2002). Manual-dexterity in instrumental activities of daily living (Monk et al., 1992). Longitudinal studies reporting on long-term care of older adults show that the presence of joint impairment of the extremities is likely to affect dexterity in instrumental activities of daily living (Dunlop et al., 1998).

Not only do physical impairments affect dexterity, but, cognitive impairments also affect dexterity. Kluger et al. (1997) studied the relationship between cognitive impairments and motor behavior in older adults. They conclude that fine and complex motor tasks, involving tracking and manual dexterity, are able to distinguish between older adults with normal cognitive functioning and older adults exhibiting mild cognitive impairment or older adults with mild Alzheimer’s disease, as effectively as cognitive tests of memory and language. Hence, task performance on manual-dexterity tasks may be useful predictors of future cognitive disability in older adults. Our study did not formally measure the cognitive abilities of the older adults participating in our study. All adults who participated in the study self-reported that they were able to read and write and understand the instructions provided to them. Studies (Raji et al., 2002) investigating the effect of cognitive and emotional status on subsequent lower body functioning from the Hispanic Established Population for the Epidemiologic Study of the Elderly (Hispanic EPESE) have shown that, among older Mexican American adults, both cognitive function (measured by the Mini-Mental State Examination) and emotional health (measured by the Center for Epidemiological Studies-Depression (CES-D) scale) affect the performance measures of lower body functioning including a timed 8-foot walk, rising from a chair five times, and a hierarchical standing balance task. The relationship between manual dexterity of older Mexican American adults and their cognitive impairment status remains unexplored. Further, cognitive deterioration among older Mexican American adults has been shown to be related not only to their age and educational attainments, but also to several other sociodemographic conditions including gender, immigration status, household composition, marital status, and medical conditions such as stroke and diabetes. Therefore, inclusion of older adults
with low-to-moderate cognitive functioning abilities may result in a downward revision of the estimates of manual-dexterity measures in our study.

There is also evidence from the Hispanic EPESE to indicate that while approximately 6% of older White Americans reside in nursing homes, only between 2% and 3% of older Mexican American adults reside in nursing homes. This is due to the unwillingness or the inability of Mexican American families to formally institutionalize their older family members. As a result, Mexican Americans who are institutionalized tend to be more functionally impaired (Markides and Wallace, 1996; Espino and Burge, 1989; Chiodo et al., 1994; Rudkin et al., 1997). Exclusion of this factor in our pilot study may have resulted in this study’s overestimate of manual-dexterity measures.

To determine if age-related decline in manual dexterity results from diminished tactile function in older adults, Cole et al. (1998) measured the time taken by younger and older participants to grip (with the thumb and index finger), lift, and transport a metal sphere when vision was permitted and when participants were blindfolded. Results of their study show that older adults needed more time during the grip-lift phase of the task, regardless of the visual condition. They also found that the grip-lift duration in the blindfolded condition was about twice the duration recorded when participants were allowed to see the metal sphere during the task. Hence, there is no support for the hypothesis that older adults’ ability to grip and lift objects is limited by changes in the availability or use of tactile information. The relationship between disability and physical activity measures such as manual dexterity is not well modeled at this time, although this relationship may be critical in explaining the pathways to disability. van Heuvelen et al. (2000), for example, found that measures of physical activity such as walking endurance, grip strength, manual dexterity and balance may be useful predictors of disability in older adults.

Models predicting disableness process (Peek et al., 2002) in older Mexican American adults hypothesize that functional limitations will be the main pathway through which disability in older Mexican American adults will be affected, and that functional limitation will be the intermediate step between pathology and impairment and a person’s ability to perform physical and social activities (disability). Results from validation of the disableness process model among older Mexican American adults will assist in understanding further limitations in dexterity, and ways to enhance dexterity in an effort to slow the disableness process.

5. Summary

This paper reports results from an experimental study conducted to investigate the manual dexterity of older Mexican American adults. Given the need among older adults for economic independence (and the associated need to work), and the need to live independently, it is important for employers of older adults to know the functional capabilities of older adults. As discussed in this paper, several research questions regarding functional performance decline in older adults remain unanswered. The effect of reduced capacity on production and work standards in industry needs to be examined not only for accommodation of older adults in the workforce, but also so that industry can maintain its productivity.

Acknowledgements

The authors acknowledge the assistance of the older adults who participated in this study. The University of Texas at El Paso provided significant financial support for this research.

References


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